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(54) **NEURAL PROSTHESIS SYSTEM AND METHOD OF CONTROL**

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CPC ***A61N 1/36003*** (2013.01); *A61N 1/36017* (2013.01); *A61N 1/36135* (2013.01)

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See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,839,594	B2	1/2005	Cohen et al.	
2001/0000187	A1	4/2001	Peckham et al.	
2003/0139783	A1	7/2003	Kilgore et al.	
2005/0096521	A1	5/2005	Andersen et al.	
2005/0171577	A1*	8/2005	Cohen	A61N 1/36003 607/48

OTHER PUBLICATIONS

International Search Report issued on Mar. 11, 2009, in International Application No. PCT/US2009/032702.

* cited by examiner

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(57) **ABSTRACT**

Multiple designs, systems, methods and processes for control using electrical signals recorded from clinically paralyzed muscles and nerves are presented. The discomplete neural prosthesis system and method for clinically paralyzed humans utilizes a controller. The controller is adapted to receive a volitional electrical signal generated by the human that is manifest below the lesion that causes the clinical paralysis. The controller uses at least the volitional electrical signal to generate a control signal that is output back to a plant to change the state of the plant, which in one aspect is one or more of the user's paralyzed muscles to achieve a functional result or to devices in the environment around the user that are adapted to receive commands from the controller.

17 Claims, 6 Drawing Sheets